Towards the Prediction of Decadal to Multi-Century Processes in a High-Throughput Climate System Model

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Climate Change, Climate Variability and Land-Vegetation Feedback: A Preliminary Report on FOAM Modeling

The Fast Ocean-Atmosphere Model (FOAM) has been used to study the climate system. Three preliminary studies are carried out:

1) Holocene climate and climate variability:
The model is first tested against paleoclimate data. FOAM simulations of early to mid-Holocene climate (11,000 – 6,000 years ago) agree with most paleo observations of major monsoons (Liu et al., 2001; Harrison et al., 2001). The model also correctly simulates the change of ENSO variability through the Holocene. Based on the model simulation, it is proposed that the enhanced NH monsoon may contribute to the suppression of ENSO in the mid-Holocene (Liu et al., 1999; 2000).

2) Mechanism of interdecadal climate variability:
The model is used to understand the mechanism of decadal climate variability. In the Pacific, model simulations suggest that both the extratropical and tropical Pacific coupled ocean-atmosphere system can generate interdecadal climate variability. In addition, tropical-extratropical oceanic teleconnection seems to enhance the tropical decadal variability (Liu et al., 2001). In the Atlantic, model simulations suggest that the decadal variability can be generated within the tropical Atlantic ocean-atmosphere system, while North Atlantic Oscillation also affects the magnitude of tropical Atlantic variability (Liu and Wu, 2000; Wu and Liu, 2001).

3) Coupled climate-land vegetation system:
A sensitivity study suggests that deforestation in the Indonesian Archipelago, amplified by ocean-atmosphere feedback, could result a significant SST change in the tropical Indian Ocean (Delire et al., 2001). Furthermore, a dynamic land-vegetation model (LPJ) is being coupled to FOAM (Gallimore and Prentice, 2001), which will later be used to study environmental impact and feedback of land-ecosystem on climate.

References

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